COMMENTARY

The well-fed woman warbles

This is the 362nd and final commentary I've pounded out as Editor-in-Chief of *Electric Light & Power*. Now it's off to greener pastures (and warmer climes) and the opportunity to do some of the things I've put aside over the 34-plus years I've toiled in *EL&P*'s editorial and sales garden. Florida beckons for the winter, and in the Spring Joyce, my wife of 39-plus years, and I will retreat from sultry southern temperatures to head for our lodge in the Maine woods.

For years I've joked that I didn't know what I wanted to be when I grew up. Now I know. I want to be retired.

So I'm off to other things. But afraid to go cold turkey, I will still keep my journalist's hand in by acting as Editorial Director of *Power Delivery Product News*, our new quarterly magazine reporting on transmission, distribution and load management/conservation products and services. *PDPN* will premiere in January. Computers and modems make almost all things editorial possible from anywhere I go.

These years with *EL&P* have been exciting and rewarding ones. I've been privileged to meet and know many of the finest people God ever put on this earth...the men and women who manage, engineer and operate the greatest electric system in the world and who are deeply dedicated to serving their customers. Great people; I've never known one I wouldn't want for a next-door neighbor.

Over the years I've witnessed first-hand the technological explosion in the electric industry...the advent of commercial nuclear power, development of EHV and then UHV transmission, underground distribution first, and subsequently underground transmission. Other technologies developed since I joined *EL&P* in 1955 include pump-storage and low-head hydro technology; barehand live-line maintenance even at EHV levels; helicopter construction of transmission tower-lines and substations; thermography; SCADA; remote metering; combined-cycle generation, HVDC, fluidized-bed combustion, fiber-optic communication, geothermal power conversion...the list could go on and on.

As a journalist, these were exciting years. Initially, of course, electricity was just *there*, no problem. Rates kept falling. Utility organizations could do little wrong. Electric energy was predicted to become too cheap to even meter. Electrification of the nation was virtually complete; service reliability was almost perfect. Then came the Northeast Blackout of 1965, which challenged the engineering and operating policies behind integrated, interconnected systems. In the late '60s environmental challenges were hurled at the industry for the first time. A few years later the Arab Oil Embargo threw energy economics onto a cocked hat. From a Congress that scarcely recognized energy as a subject worthy of even casual discussion (except when there was a hydro project's political windfall involved), we've progressed to a Congress where almost every member professes to hold at least one major key to solving the nation's energy problems and guaranteeing an abundant energy future. It's really gotten progressively interesting since the early '60s

I feel good about *EL&P* and what it has become. The staff is dedicated, talented and ready to do even more in the years ahead. Bob Smock, who was a member of the *EL&P* staff for 15 years before becoming Editor of our sister publication, *Power Engineering*, returns as my successor and becomes Editorial Director of both *EL&P* and *PE*. After 34 years *of EL&P* being almost as much a part of my family as my wife and daughters, I would hate to retire without confidence that the magazine's editorial direction was in good hands. With Bob coming back to head up the *EL&P* editorial program, I have no concerns on that score.

To each of you who've read these commentaries over the years, thanks for your time, your support and your suggestions and criticisms. The pleasure's been all mine, I assure you. I've had a ball.

And with that, I suppose all that's left is to turn out the light and close the door...and listen...yessir, like the man suggested, you know it's all over when the fat lady sings.

Robert A. Lincicome, Editor-in-Chief

Happy holidays to all our readers from the EL&P editorial staff

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Bob Lincicome "retires" from EL&P

After 34 years of service to *Electric Light & Power* magazine, and seeing the publication grow again out of the soft 80s, Bob Lincicome is removing his mantle as Editor-in-Chief of *EL&P* turning the leadership role over to Bob Smock, presently editor of *Power Engineering* magazine. Mr. Smock becomes Editorial Director of both *EL&P* and *PE*.

Bob Lincicome started with *EL&P* in 1955, then took a brief sabbatical in the early 60s. He returned to the magazine in 1963 as News Editor and soon became Business Editor. Bob then moved up to the position of Managing Editor and in 1970 he was named Editor-In-Chief.

Bob Lincicome has seen the electric utility industry change and evolve with mergers and acquisitions, growth and no growth, new leadership and new directions. He used his editorial page to compliment and to chastise, to report and to discuss, to make a stand and to open up discussion. Most importantly Bob wrote for and about the industry...an industry which he has been proud to serve and promote.

In 1970 Bob was named to the Edison Electric Institute's Award Nomination committee. Lincicome was named Chairman in 1971 and has served in that capacity ever since. He has enjoyed the challenge of selecting the candidates and working with EEI and their associates.

Bob has authored numerous articles dealing with the electric power business and has lectured at various schools and universities. He serves on the PowerGen Program Committee and other industry committee groups.

You may have seen Bob and his wife, Joyce, while attending industry functions, such as the Southeast Electric Exchange, EEI's Annual Meeting, UPMG and USCEA. All of you have met Bob through his *EL&P* Commentary.

While Bob is "retiring" from *EL&P*, he is "joining" us as editor of our new venture, the quarterly product tabloid *Power Delivery Product News*. Bob figures he can handle this challenge while he handles the equal challenge of building his "retirement" home in the Maine woods.

Bob, congratulations on what you have done to not only build *EL&P* but the electric utility industry as well. Thank you for your tireless effort and support. Best of luck and have fun!

Sincerely,

Arthur L. Rice
Publisher

TVA enters year 5 without a rate hike

KNOXVILLE, TN—TVA will require no rate increase for the fifth consecutive year and is continuing restructuring efforts to make itself, and the region, more economically competitive. TVA's last rate increase was granted in 1987.

In the past three years, about 1600 industries have announced plans to locate or expand in the Tennessee Valley region, creating almost 90,000 jobs, TVA noted.

William F. Malec, TVA's chief financial officer and senior vice president of Finance and Administration, said that TVA's operating results through the third quarter of fiscal year 1991 and financial projections for fiscal year 1992 enabled him to recommend that electric rates be held constant for a fifth consecutive year.

Malec noted that the company's key managers last year challenged themselves to work toward another year of rate stability.

"We have received tremendous support from our employees and can achieve that goal," Malec said. "TVA has achieved cost efficiencies and expense reductions unparalleled in the electric utility industry. By keeping costs down, increasing efficiency and producing reliable power, we all have helped make TVA and the Tennessee Valley stronger and more competitive," he said.

Between 1988 and 1991, TVA reduced annual operating expenses by more than $250 million.

In 1992, operating expenses are projected to drop to $3.3 billion, well below the 1988 figure of nearly $3.5 billion. The decrease is expected although TVA anticipates a 12-billion kWh increase in power production for the same four-year period.

TVA's total interest expense in 1992 is anticipated to be $1.7 billion, compared to $1.9 billion in 1988.

Sales, generating mix, future

TVA's power sales are expected to increase by about four percent in 1992, Malec said. Municipals and cooperatives receive more than 80 percent of TVA's output; industries receive almost 15 percent.

In 1990, TVA's 11 coal-fired plants produced 68 percent of its electricity; 29 hydroelectric dams, 19 percent; the Sequoyah Nuclear Plant, 13 percent.

Clean-air compliance strategies were expected to be discussed at the Nov. 20 board meeting.

Nuclear generation is expected to contribute a greater percentage of TVA's power with the restart of Browns Ferry Unit 2. That unit, in Athens, AL, resumed power generation this summer, for the first time in six years. Unit 3 is scheduled for operation in 1993. Chairman Marvin T. Runyon has mentioned that within two or three years, TVA may be a candidate for the nuclear industry's next nuclear plant order.

Total revenue for 1992 is expected to be about $5.4 billion, up from 1988's $5.3 billion. While Department of Energy payments to TVA decreased from $521 million in 1988 to $160 million in 1992 (see below), non-DOE revenue increased from $4.8 billion in 1988 to $5.2 billion in 1992.

Out of construction

Another way TVA has cut costs is by its decision to leave the construction and modification business. About 500 permanent TVA employees were affected.

TVA's Generating Group President Oliver D. Kingsley Jr. explained, "TVA

Continued on page 12

NERC: clean-air regs, transmission EMF/access issues threaten reliability

PRINCETON, NJ—Electric utilities' increasing reliance on short lead-time generating resources has made their 10-year plans less detailed than in the past.

Even so, major reliability concerns, taken from analysis of those plans, include the effects of clean-air regulation, the increasing role of non-utility generation and transmission siting and access issues, according to North American Electric Reliability Council's "Reliability Assessment 1991-2000." (See tables this page.)

In that yearly report, NERC identified six key issues that will affect reliability during the next 10 years. These are:

- **Effects of clean-air regulations.** "Uncertainties about mining and transportation, and the timely availability of equipment and skilled labor are concerns."
- **Fuel supply adequacy.** Expected significant increases in utility use of natural gas has some utilities extremely concerned about fuel availability, especially during cold snaps, and startup of peaking combustion turbines.
- **Greater operational complexity.** Operating interconnected electric systems will become more complex with the effects of clean-air regulations, proliferation of non-utility generators and increasing demands for transmission services.
- **Transmission siting, services.** Expansion of transmission is very difficult due to increasing obstacles to siting and certification, partly from concerns about alleged adverse effects of electric and magnetic fields. "Increasing demands for transmission services, including legislative proposals for mandated services, could jeopardize reliability."
- **Changing business environment.** "Increasing use of NUGs and demand-side management means electric utilities will have less direct control over the resources needed to maintain reliability. Also regulatory impediments continue to be disincentives to maintaining reliability."

During the next 10 years, the U.S. will get 20 percent of new capacity from NUGs (17,700 MW). Canada will receive 10 percent, or 2400 MW. By 2000, NUGs will represent more than 4 percent of capacity in the U.S. and more than 2 percent in Canada.

U.S. peak demand will grow by 1.9 percent per year; Canada, 2 percent.

Complying with clean-air regulations means increasing some coal mine production by as much as 170 percent, having adequate numbers of rail cars, and having various manufacturers supply equipment orders in time. Deadline compliance in 1995 and 2000 may make emergency generating resources less available, and require that transmission lines carry greater loads, according to NERC.

Generating Unit Additions, Changes, and Retirements (1991-2000 Forecast)

	United States		Canada		NERC-Total*	
Type	Thousands of MW	% of Total	Thousands of MW	% of Total	Thousands of MW	% of Total
Nuclear	5.9	6.6	2.6	11.5	8.6	7.5
Coal	15.1	17.0	1.9	8.3	17.7	15.6
Hydro	1.1	1.2	12.7	55.0	13.9	12.3
Oil/Gas	34.2	38.3	2.3	9.9	36.8	32.5
Pumped Storage	2.5	2.8	0	0	2.5	2.2
Other (Utility)	12.8	14.3	1.1	4.8	13.9	12.2
NUGs (Net Additions)	17.7	19.8	2.4	10.5	20.1	17.7
Additions	89.3	100	23.0	100	113.4	100
Changes	10.6		0.4		11.0	
Retirements	-4.3		-0.5		-4.8	
Net Total	95.7		22.9		119.6	

* Includes additions in WSCC-Mexico.

Source: NERC Reliability Assessment 1991-2000.

Preliminary Electric Utility Responses[a] to the U.S. CAAA of 1990 - Phase I

	Capacity Affected	
	Thousands of MW	% Total
Fuel Switching		
Low-Sulfur Eastern Coal	29.2[b]	37.1
Low-Sulfur Western Coal	14.7[b]	18.7
Low-Sulfur Local Coal	1.9	2.5
Natural gas	2.4	3.1
Other	1.5	1.9
Subtotal	49.7	63.3
Scrubber (FGD System) Additions	19.5	24.7
Emission Allowances	8.4	10.7
Unit Retirements	0.3	0.4
Unknown	0.7	0.9
Total	78.6	100

[a] As of June 1991.
[b] Corresponds to additional coal production requirements of about 70-million tons/year for low sulfur Eastern coal and about 50-million tons/year for low sulfur western coal, based on a 65% capacity factor.

Source: NERC Reliability Assessment 1991-2000.

from page 4

TVA—streamlining a giant...

is adopting the standard utility practice of hiring private contractors for major construction and modification projects, such as the completion of Watts Bar Nuclear Plant, modification of Browns Ferry Unit 3 and work to comply with the Clean Air Act," Kingsley said.

"Our aim is to be the best power plant operator in the utility industry. We're going to get there by concentrating on excellence in operation and maintenance of the power system, which is our basic business."

Kingsley emphasized that local craft workers will continue to be employed in construction projects formerly performed by outside contractors. He said the number of TVA construction and modification jobs will increase in the future as a result of fossil and hydroelectric plant modifications and continuing work on TVA's nuclear facilities.

As part of the changes, TVA and the Tennessee Valley Trades and Labor Council signed new agreements. The agreements allow more flexibility in maintenance and construction work and allow TVA to deal with fewer unions performing permanent work within its power plants.

Under terms of the new agreements, contractors for all projects of $250,000 or more will hire their trades and labor workforce through referrals from the unions currently representing TVA employees. Contracts below $250,000 and certain specialty contracts will not be required to follow the new agreements.

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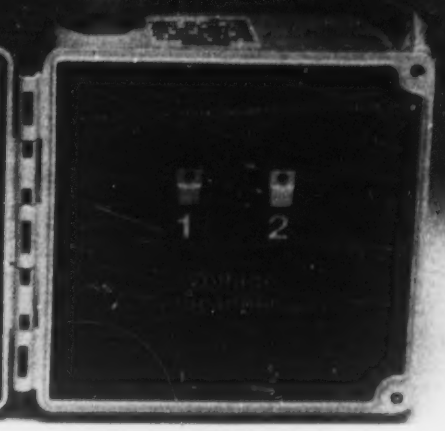

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Inquire R.S. 14

WAYNE BEATY, Senior Editor-Power Delivery

Information on software available with new directory

BARRINGTON, IL—The new 1992 *EL&P Electric Utility Industry Software Directory* now is available. It provides instant access to the latest software programs and sources including programs for line design, construction, transformer loading, compliance with federal regulations or any number of about 60 other categories.

First of its kind

When issued for the first time last year, the directory was the first of its kind for the industry.

The new *1992 Directory* lists almost 600 programs from 250 vendors including some electric utilities and international vendors. All information is listed alphabetically by program title within application categories and alphabetically by supplier with the programs each offers.

Each listing includes a comprehensive description of the software, the appropriate operating system(s), special accessories, compatibles, language/memory requirements, the supplier's name and, when available, the price. It also gives the current address, phone, fax and telex numbers plus a contact name for each supplier.

Categories

Some typical categories include:

- About 30 programs on accounting/statistics/management functions and techniques.
- Some 20 programs on automated mapping/facilities management/geographic information systems.
- Cable systems—To help design systems, calculate pulling tensions, ampacity, voltage drop, etc.
- Civil engineering programs calculate transmission tower footings and anchors.
- Cogeneration—All the technical aspects of various types of cogeneration projects are considered, including economic feasibility, detailed cash flow statements, equipment selection and purchase and generation of electricity and steam.
- About 25 distribution system design programs. Includes substations, primary feeders, secondary, services, reliability and restoration procedures following outages.
- Engineering—with all the classic stress analysis, heat transfer, power flow, haramonic simulation, voltage calculation, fault analysis, and other problems.
- Environmental compliance programs.
- Fuel supply for both electric and gas utilities. Some calculate heat balances for fossil fuel (including coal, natural gas, oil, waste, wood), combined-cycle, nuclear, and repower units. Data on price of fuel includes cost comparisons, supplier validations, price trends, studies and fuel mix analysis.
- Generation—Over 100 programs for design, operation, maintenance, analysis and planning.
- Energy and load management for modeling residential, commercial and industrial loads and their effects on the power system. This category also includes transformer inventory and load management (TILM) programs.
- Maintenance programs for generation, transmission, substation, distribution, warehouse and yard inventory, and tree trimming.
- About 25 programs that deal specifically with marketing electric energy.
- System operations—including forecasting techniques and analysis, stability programs, power flow analysis, and simulators.
- System protection and fuse coordination.
- Training/education.
- Transformers.
- Transmission systems—including design, construction, operations and maintenance.
- Transportation and vehicles.

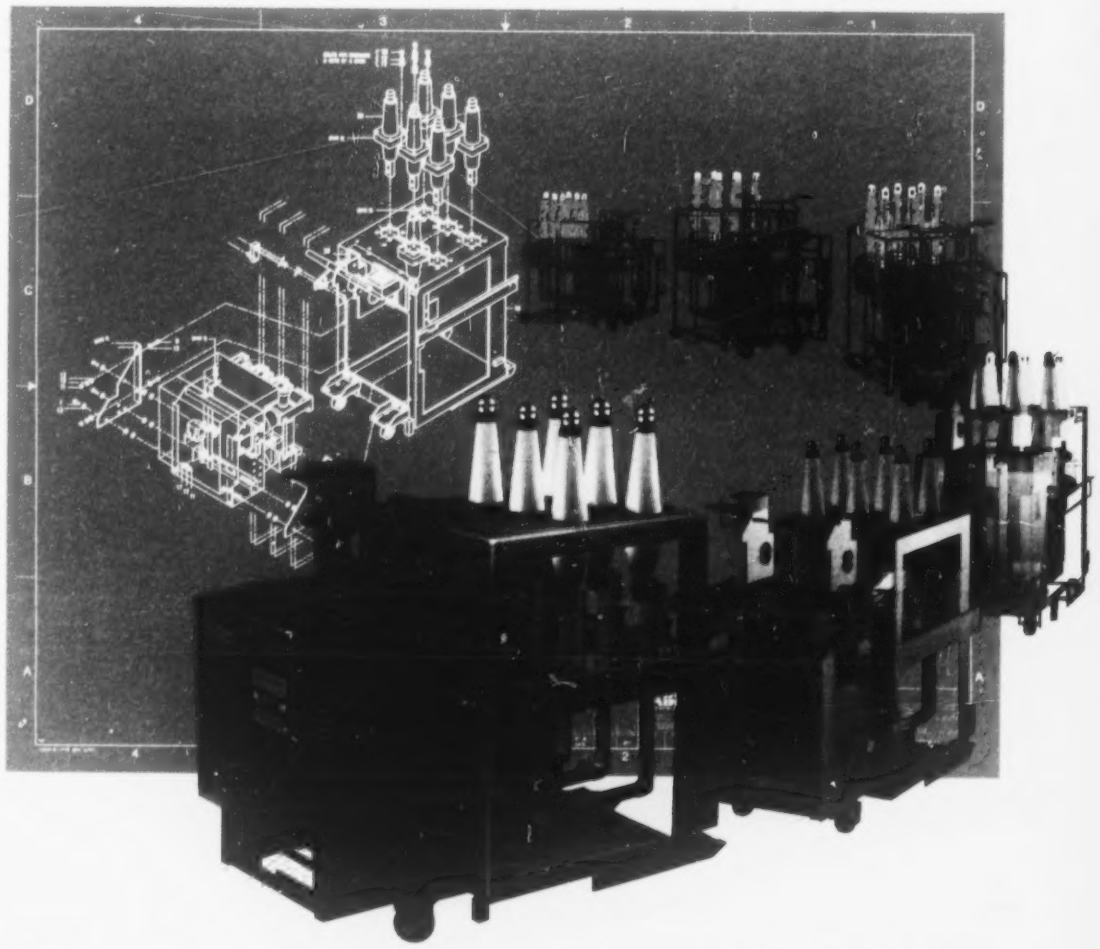
New programs are being written and introduced to the industry almost weekly so the directory will be kept current at each new publishing.

Add a program

To add a new program listing for the next directory, contact Wayne Beaty, Senior Editor—Power Delivery, EL&P, 1250 S. Grove Ave., Suite 302, Barrington, IL 60010; ph. 708/382-2450, fax 708/382-2977.

Correction

An *EL&P* table (9/91, p.3) should have listed electricity rates for Louisiana Power & Light Co., as 5.7 cents per kWh in April '91, and 5.8 cents per kWh in April '90, based on 1000 kW for 450 MWh per month. LP&L is a subsidiary of Entergy.



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Inquire R.S. 17

Long-term incentive plans for executives gain favor

Christopher R. Healy
Matthew G. Martin
Hewitt Associates

LINCOLNSHIRE, IL—In a game of "catch up" with general industry, major electric utilities increasingly are adopting long-term incentive plans as part of the total compensation package provided to executives.

Among 60 large utilities (primarily electric, with average revenues of $2.5 billion), two-thirds currently have some type of long-term incentive arrangement—about twice as many as five years ago. This recent growth has narrowed the gap between electric utilities and "general industry" where more than 90 percent of employers have one or more long-term incentive plans.

Long-term incentive plans—which include stock options, restricted stock and performance share/unit plans—are intended to reward executives for improving company performance as measured externally by stock price/dividend yield or internally by accounting-based financial measures. These plans are usually limited to the most senior executives in an organization—typically the top 1-3 percent of the salaried exempt population, usually those executives earning $90,000 or more in base pay.

Similar to annual bonus plans, long-term incentives shift a greater portion of an executive's total compensation from "fixed" pay (in the form of base salary and benefits) to "at risk" pay.

Award sizes are more conservative than in general industry, in-part because long-term incentives are still relatively new among utilities. For example, the median annualized stock-option award size for a utility CEO is 125 percent of salary—compared to 175 percent of salary for their general industry counterparts. For performance-share or unit plans, median awards for a utility CEO are 45 percent of salary versus 60 percent in general industry. Restricted-stock median awards for utility CEOs are 35 percent and 45 percent of salary, respectively. (Award size is determined by share price multiplied by number of shares divided by salary.)

From another perspective, the value of long-term incentives for utility CEOs typically represents only about 20 percent of total compensation. In contrast, for general industry CEOs long-term incentives comprise about 40 percent of total compensation. As long-term incentives become more common and widely accepted in the utility industry, their value is expected to become a larger portion of the pie.

Among the factors contributing to the explosive growth of long-term incentives in the utility industry is the need to provide competitive compensation packages.

To attract and retain top executives from other industries, long-term incentives are being viewed as necessary—especially for utilities diversifying into non-regulated businesses.

Some managements also recognize that a longer-term orientation to compensation provides more support for planning and investment cycles. In addition, many utilities are seeking ways to create a stronger link between executive compensation and the interests of shareholders and customers. And finally, with continuing deregulation, utilities are experiencing greater competition—and that means management needs to increase its focus on long-term financial performance.

However, regulators may not allow a utility to include the cost of a long-term incentive plan in rate base unless the plan explicitly serves customer interests. If disallowed, shareholders must bear the cost. In addition, regulatory limits on rate increases can prevent management from maximizing profits and, potentially, stock price appreciation—measures typically used in long-term incentive plans. Both issues mean utilities have to give special consideration to performance measures in long-term plans.

Other barriers include an organization's culture, which may not support long-term incentives; the potential for negative publicity on a highly sensitive issue; and resistance to incentives—which may come from executives, shareholders or customers.

The most common long-term incentive arrangements among utilities are stock option plans. (See table.)

Stock option plans, which reward executives for price increases in stock, are less common among utilities than general industries. One reason may be that regulations usually limit utility earnings—so the upside potential of stock appreciation is not as great. However, since dividend yields tend to be higher among utilities, some utilities have added dividend equivalents, thus heightening the focus on total shareholder return.

Long-term Incentive Plans

	Utility	General Industry
Stock Options	46%	80%
Performance-based Plan	40%	48%
Restricted Stock	34%	44%

Totals exceed 100%. Some employers have multiple plans.

Performance-based incentive plans appeal to utilities, allowing more flexibility and creativity in defining performance measures that benefit customers and shareholders. A utility might use net operating income and/or earnings per share along with some customer-related measure, such as service rates compared to a peer group of utilities or cost per kilowatthour. Measures tied to demand-side management also are becoming more common as utilities increase efforts to encourage efficiency and lower customer costs.

Restricted stock, which provides executives with an outright grant of stock subject to a specified holding (or "vesting") period, is used primarily as a retention tool. With some utilities seeing their historically low executive turnover rates begin to rise, restricted stock may become more common. In general, it is used less often than other vehicles because some employers and shareholders view it as a "giveaway."

Long-term incentive arrangements will continue to grow in prevalence and importance among electric utilities as a way to ensure competitiveness and support the commitment to shareholders and customers.

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Inquire R.S. 18

NRC AI team reports on Wolf Creek

WASHINGTON—The Nuclear Regulatory Commission sent a five-member Augmented Inspection Team (AIT) to the Wolf Creek nuclear power plant, located near Burlington, KS, to look into the effects of a partial loss of power there on Sept. 23.

Power loss effects

The power was being supplied from offsite, and the onsite loss caused a tripping of two reactor cooling pumps, loss of a circulating water pump, and loss of service air to the spent-fuel-pool transfer-canal boot seal.

When the seal was lost, 6-8 ft of water leaked from the top of the spent fuel pool into the transfer canal, rendering the spent-fuel system inoperable. However, the spent fuel did remain covered with water.

The plant was shut down for refueling when the partial loss of power occurred about 10:35 a.m. But the water leak was not discovered until about 12:15 p.m.

The AIT planned to develop a better understanding of the intiating event, its significance for safety, and potential concerns for all similar nuclear generating plants. Its onsite work began on Sept. 25, and the group finished on Sept. 30. The report was ready in late October.

The team:

- Reviewed documentation, plant conditions at the time and the sequence of events.
- Assessed plant structures, systems and components that caused, contributed to or were used during the event.
- Review operator and management response to the event.
- Assessed plant conditions that mitigated it.
- Reviewed procedures, alarms and indications.
- Reviewed contingency actions associated with plant conditions.
- Looked into shutdown risk and human factors involved.
- Reviewed corrective actions planned by the operator, Wolf Creek Nuclear Operating Corp.

No nuclear incident had to be declared due to the power loss.

HENRY STEIN, Senior Editor-Power Production

Dealing with zebra mussels

ITASCA, IL—The map shown here says it all—or almost all. If your power plant is located within the striped-and-shaded area of the continent and on any kind of waterway, you will probably have to deal with zebra mussels in the near future.

Unfortunately, not being within the striped area does not necessarily preclude the mussels, *Dreissena polymorpha*, from reaching your facility.

A maybe

The area shown, which contains 70 percent of U.S. power plants and a large number of Canadian ones, is merely an estimation, based on temperature ranges the striped mollusks find hospitable—32°-90°F—made up by Anthony F. Armor, head of the EPRI Zebra Mussel Task Force. Even he admits that, at most, the shaded area is only a "best estimate" as to their spread throughout North America.

The bright red highlights, on the other hand, show areas where the bivalves have already been found living and causing problems, as reported at the October Electric Utility Zebra Mussel Technology Conference by the Zebra Mussel Information Clearinghouse. Those areas include all five Great Lakes, the Erie Canal, the St. Lawrence River, the Ohio River, the Illinois River and the Hudson River.

Armor further warned of the speed with which the mussels colonized areas such as the Great Lakes, sometimes in quantities of 10,000 or more per square meter, 6-in. and more deep. Even greater concentrations have been found in Europe, up to 100,000/m^2, from where they emigrated to this continent.

A new problem

He noted that one problem had not yet been addressed, namely what might be the effects of mussel shells that had been removed from a power plant and had to be disposed of, most probably in a landfill. The first problem would be filling up the landfill. But the second, and possibly more important one, could be the toxicity the shells might impart to the area.

Utility, government responses

Thomas Maiman, vice president of engineering of Commonwealth Edison, told of his company's thermal treatment to control zebra mussels at its State Line Plant on Lake Michigan. By recirculating water back into the intake bay inside the lake breakwall, he raised the temperature at the plant intakes there to 93°-99°F for 6 hr and achieved a 100-percent kill of the mollusks.

Maiman also pointed out something new that was not in the literature—the effect on the native clam population. Many native clams have become covered with zebra mussels. The native species, he concluded, may be headed for extinction.

Kenith Fenner, of Environmental Protection Agency Region 5, warned that when developing strategies to deal with the mussels utilities should:

- State authorization is needed for introducing new chemicals or biocides. But get the EPA involved, too, since the state authorities are probably going to contact the EPA anyway before authorizing anything.
- Maintain biological water quality standards.
- Do not use unregistered pesticides.
- Consider whether plans meet the idea of "good science."
- Permit requirements are legally binding documents.

A new concept was presented by John Holsapple of Empire State Electric Energy Research Corp. (ESEERCO) who said there was pressure to move away from chemical zebra mussel treatments. He described an acoustic method for breaking the shells of the veligers (the larva stage) in 5-6 sec and those of juveniles in 7 min, and killing adults with 18-hr exposure.

The effects were most lethal to the smaller specimens, but those effects depend on frequency, sound pressure level and time.

ESEERCO is continuing further research along these lines.

Detroit Edison, on the other hand, uses mechanical cleaning to keep its Monroe Power Plant on western Lake Erie operational. Mussels are removed from trash bars by underwater hydrolasing at 3000 psi. The mussels dislodged drift onto traveling screens that turn continuously during the cleaning operation. Leaf rakes scrape them off the screens for collection and disposal.

In addition, waterboxes are scraped clean with hooked picks, and screenhouses are now mechanically cleaned during scheduled outages. Zebra mussels are removed from walls and basement floors of screenhouses by dewatering and hydrolasing from rubber boats as the water level drops.

That's a lot of mussels!

Three of the four Monroe units were cleaned in late 1989-early 1990. Each cleaning yielded 50 yd^3 of the mussels weighing 15 tons. Cleaning the fourth unit in fall 1990, yielded approximately 100 yd^3 of the mollusks weighing about 30 tons. The overall average cleaning cost is about $4/yd^2/yr.

William Kovalak, principal biologist, says DE now is looking into various coatings (as is Niagara Mohawk Power) with a view to preventing or minimizing the buildups of the past, and also is experimenting with underwater sandblast spraying, as is done on oil platforms. DE estimates zinc-and-copper or silicone coatings will cost approximately $12/yd^2.

Kovalak also mentioned DE's experiments, which are continuing, of introducing two fish that eat zebra mussels.

More conferences

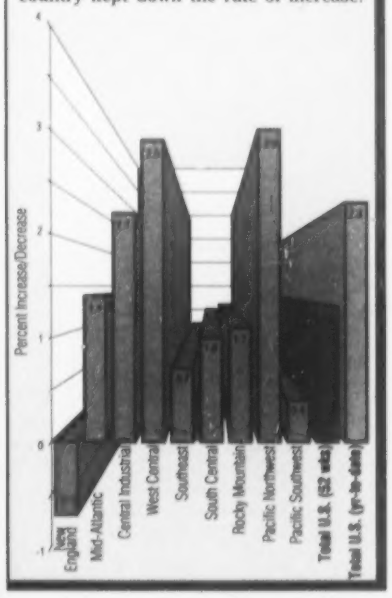
Additional conferences on zebra mussels, the damage they are causing, and how to control them are planned for the near future. The Second International Zebra Mussel Research Conference was to be held in Rochester, NY, Nov. 19-22, and the Second International Zebra Mussel Conference is to be convened in Toronto, on Feb. 19-21.

Plans are to hold the the Electric Utility Zebra Mussel Control Technology Conference at approximately the same time again next year as this year's.

ELECTRIC OUTPUT

Some Growth Slowed

Net electric output from the Mainland U.S. electric utility industry continued its gradual increase for the 52 weeks ending Nov. 1, as reported by Edison Electric Institute. Mild weather in most of the country kept down the rate of increase.



Device installs epoxy linings in inaccessible piping

WEYMOUTH, MA—A unique application device permits installation of 100-percent solid epoxy linings in corroded piping that previously has been inaccessible using conventional methods.

The new equipment is a one-of-a-kind plural application system that can run through as much as 200 ft of straight piping with diameters to 30 in. It can apply a thick restorative lining to corroded pipes, using a remote camera and robotic equipment, located in underground and other normally inaccessible areas.

Previously, serious pipe corrosion called for replacement of the pipe, which, said Tom Gardner, technical services director for Arcor, the supplier of the service, "means big money in terms of direct costs, as well as downtime." The system returns piping to like-new performance.

More information is available from Arcor, 221 Libbey Industrial Parkway, East Weymouth, MA 02189; phone 800/878-9593.

Geothermal is poised on the brink

Ken Nichols, CEO
Mike Forsha, Engineering Manager
Zane International Inc.

BOULDER, CO—Geothermal generating sources have developed so quickly and quietly in the Western U.S. that even some knowledgeable utility people are surprised when they hear of the extent. But development has just begun.

From less than 200 MW of installed capacity in 1970, the total has climbed to more than 2800 MW online today. And worldwide, a 15-percent annual growth rate has persisted since 1978.

At costs of $1,500-$2,000 per installed kilowatt, geothermal plants sited on good quality sources are getting cost-competitive with fossil-fuel power plants. In addition, geothermal plants were online an average of over 95 percent of the time, compared to approximately 75 percent for coal and 65 percent for nuclear.

The worldwide growth rate has been driven, to a large extent, by R&D improvements in plant and well technology. In some early plants, high brine levels would scale pipes almost shut, while in others, the brines would severely corrode the equipment.

Another driving force has been government-mandated reduced emissions and other environmental concerns. Compared to a fossil plant, geothermal atmospheric emissions are low, and little pollution control equipment is needed.

In addition, geothermal is the only renewable energy source that does not depend on the vagaries of sun, wind and rain.

Regulatory environment

Regulations over the past several decades have alternately promoted and discouraged development of hydrothermal resources. Under the tax breaks of the Carter Administration in the '70s,

Continued on page 22

Power delivery construction survey shows plans thru 1996

EL&P exclusive report

BARRINGTON, IL—*EL&P's* annual power delivery construction survey indicates utilities are changing their purchasing and construction methods, especially for underground systems.

The results are based on 95 responses from major investor-owned, cooperative, municipal and government electric utilities.

Load growth will be in the range of 2.5 percent with the residential sector growing by 2.1 percent and commercial/industrial by 2.5 percent.

A wide range of voltage levels is in use:

- Interconnections and tielines: 76 percent are rated 115-138 kV.
- Intrasystem transmission: 81 percent are rated 115-138 kV.
- Intrasystem subtransmission: 37 percent are 35 kV.
- Distribution primary voltage is predominantly 15 kV (87 percent).

About 2.3-million miles of overhead transmisssion rated 69 kV and above were in operation in 1991. The responding utilities will add 113,788 miles of overhead transmission lines to their systems during 1992-96. Some 30 percent of the additions were for 138-kV lines. The next highest amount was 20,290 miles of 230 kV (18 percent).

About 15,000 miles of underground transmission lines are in operation by the 95 companies. They plan to add 1800 miles in the next five years. The most dominant underground additions will be for 115 kV, 138 kV and 230 kV.

Almost 11 million miles of overhead distribution lines are in service. By far the predominant voltage is 15 kV (64 percent). Over 7-million miles of this voltage class are in operation. In the next five years, utilities expect to add almost 700,000 miles of overhead lines—mostly in the 15 kV and 25-kV class.

Over 2-million miles of underground distribution lines are operational and plans are being made to add almost 436,000 more in the next five years. Some 52 percent of the additions will be 15 kV and 24 percent rated 25 kV.

The following table indicates the predominant type of underground installation in use today.

	Transmission	Primary Distribution	Secondary Distribution	Services
Conduit	31%	27%	22%	15%
Direct Buried	11%	63%	64%	66%

Plans for future construction of underground distribution indicate more lines will be installed in conduit and fewer will be direct buried.

Respondents were asked about supervisory control and data acquisition (SCADA) and distribution automation (DA) plans. Some 85 percent had SCADA systems in use to some degree. About 80 percent expect to install SCADA systems or add to existing systems.

About 23 percent of the companies had DA systems, but an even higher number—45 percent—said they would have DA systems in the next five years.

The survey asked about the types of towers and poles used by voltage class. Wood, of course, is the predominant type for voltages under 138 kV. For 161-kV lines and above, steel lattice and tubular steel have become more popular.

When asked about the type of insulators in use on their systems, almost 90 percent said porcelain. Only 8 percent used glass and 6 percent used composite insulators. Future construction, however, calls for the use of composite insulators by some 28 percent of the utilities.

ACSR is the predominate type of conductor for overhead lines (60 percent) and will increase to 67 percent for new construction. Aluminum conductor is the predominant type for underground circuits.

Crosslinked polyethylene (XPE) is in use by 75 percent of respondent utilities for underground cable insulation. When asked what they are currently buying, 95 percent said HMWPE, 88 percent said XPE and 35 percent said EPR. Many, of course, buy more than one type of insulation.

The survey also tabulates the number of transformers by voltage class to be ordered in 1992, 1993-95, and 1996-98.

Wayne Beaty, EL&P's Senior Editor-Power Delivery, gave a summary of this report as one of two featured speakers at the "EL&P Marketing Forum," held in Dallas on Sept. 24, during the IEEE/PES Transmission and Distribution Conference and Exhibition. (See related story, p.3.) The audience was primarily marketing executives from major power delivery manufacturing and service companies.

Complete T&D survey results are available from EL&P for 815. Contact Gene Zack at 708/382-2450.

Dates set for 1992 infrared courses

CLEVELAND—American Risk Management Corp. has issued its 1992 listing for Infrared Thermography Training Courses.

Predictive maintenance: Atlanta, Feb. 18-20; Dallas, June 16-18; Sacramento, CA, July 21-23; Atlanta, Sept. 22-24.

Level I: Dallas, Jan. 20-24; Cleveland, March 30-April 3; Atlanta, May 11-15.

Level II: Cleveland, Aug. 17-21; Dallas, Oct. 19-23.

For more info call 216/447-1600.

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